PATENT ABSTRACTS OF JAPAN

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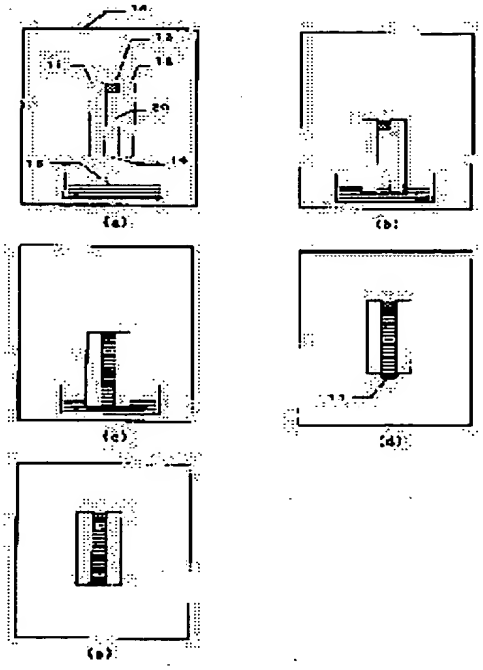
(54) PRODUCTION OF LIQUID CRYSTAL DISPLAY ELEMENT AND APPARATUS THEREFOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a processing for producing a liquid crystal display element having good display quality and end-sealing quality with a high gap accuracy and good efficiency even if a mechanical gap adjustment stage is not carried out by integrally carrying out filling and end-sealing of liquid crystals in a pressure controlled state, thereby precisely controlling the filling rate of the liquid crystals and an apparatus therefor.

SOLUTION: This process and apparatus for producing the liquid crystal display element consist of immersing a liquid crystal cell 20 which is formed by disposing a pair of transparent substrates 11 and 12 in which transparent electrodes are formed on at least one surfaces facing to each other at a prescribed interval and sealing the peripheral part exclusive of an injection port by a sealing material 13, with its injection port 14 faced downward, into the liquid crystals 15 in a pressure control chamber 16 and injecting the liquid crystals within the liquid crystal cell 20 by the pressure difference between the inter pressure and external pressure of the liquid crystal cell 20, then end-sealing the injection port 14. In the liquid filling stage, a regulated amount of the liquid crystals 15 are filled into the liquid crystal cell and thereafter, the external pressure of the liquid crystal cell 20 is reduced in such a manner that the external pressure of the liquid crystal cell 20 and the internal pressure of the liquid crystal cell 20 attain an equilibrium state.



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CLAIMS

[Claim(s)]

[Claim 1] The transparent substrate of the couple by which the transparent electrode was formed in one [which counters / at least] front face Turn down the liquid crystal cell which was made to counter at intervals of predetermined and carried out the seal of the periphery except an inlet, and an inlet is immersed in the liquid crystal of the pressure regulation interior of a room in it. In the manufacture method of the liquid crystal display element which closes an inlet after pouring liquid crystal into the inside of a liquid crystal cell by the pressure differential of the internal pressure and external pressure of a liquid crystal cell The manufacture method of the liquid crystal display element characterized by decompressing the external pressure of a liquid crystal cell in a liquid crystal pouring process after pouring the liquid crystal of the amount of conventions into a liquid crystal cell, and making it the external pressure of a liquid crystal cell and the internal pressure of a liquid crystal cell be in equilibrium.

[Claim 2] The manufacture method of a liquid crystal display element according to claim 1 of decompressing the external pressure of the liquid crystal cell of the pressure regulation interior of a room in a liquid crystal pouring process based on the measurement result which measured the area of the perpendicular direction of the oil level in a liquid crystal cell combining measurement, measurement of the liquid crystal pouring field of the perpendicular direction of the oil level in a liquid crystal cell, the thickness measurement of the liquid crystal cell inside, or the aforementioned measuring method, and making it the internal pressure and external pressure of a liquid crystal cell be in equilibrium.

[Claim 3] The manufacture method of a liquid crystal display element given in one term of the claims 1-2 which close a liquid crystal cell by the encapsulant after the internal pressure and external pressure of a liquid crystal cell will be in equilibrium.

[Claim 4] The manufacture method of the liquid crystal device according to claim 3 which stiffens an encapsulant when will pressurize the external pressure of a liquid crystal cell, the encapsulant of a proper quantity will be made to permeate and the internal pressure and external pressure of a liquid crystal cell will be in equilibrium, after closing a liquid crystal cell by the encapsulant.

[Claim 5] The manufacture method of the liquid crystal device according to claim 4 which stiffens an encapsulant when will pressurize the external pressure of a liquid crystal cell, the encapsulant of a

proper quantity will be made to permeate, the external pressure of a liquid crystal cell will be decompressed again and the internal pressure and external pressure of a liquid crystal cell will be in equilibrium.

[Claim 6] The manufacture method of the liquid crystal device according to claim 5 which stiffens an encapsulant when a detection means will detect the osmosis state of an encapsulant, the external pressure of a liquid crystal cell will be decompressed based on this detection result and the internal pressure and external pressure of a liquid crystal cell will be in equilibrium.

[Claim 7] A pressure-control means to pressurize or decompress the pressure regulation room (A) in which pressurization and reduced pressure are possible, and this pressure regulation room for the interior (B), The transparent substrate of the couple which has the move mechanism which can move to this pressure regulation interior of a room vertically and horizontally and by which the transparent electrode was formed in one [which counters / at least] front face The liquid crystal cell move means in which being immersed or ejection is possible to the liquid crystal which turned the inlet down, has arranged downward [vertical] the liquid crystal cell which was made to counter at intervals of predetermined and carried out the seal of the periphery except an inlet, and was supplied to the aforementioned pressure regulation interior of a room (C), A means (D) to supply liquid crystal to the aforementioned pressure regulation interior of a room, and a means (E) to supply the encapsulant which closes a liquid crystal cell to the aforementioned pressure regulation interior of a room are provided at least. in the aforementioned pressure regulation room (A) by the pressure differential of the internal pressure and external pressure of a liquid crystal cell The manufacturing installation of the liquid crystal display element characterized by being the thing of composition of that liquid crystal is poured into a liquid crystal cell, and an inlet can be closed.

[Claim 8] The manufacturing installation possessing a pressure-control means to be based on a means to picturize the pouring state into a liquid crystal cell, and/or the pouring state of the encapsulant into a liquid crystal cell, a means to process the picture by which the image pck-up was carried out [aforementioned], and the aforementioned processing result, and to pressurize and decompress a pressure regulation room of a liquid crystal display element according to claim 7.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] About the manufacture method of a liquid crystal display element, and its manufacturing installation, this invention pours liquid crystal into a liquid crystal cell, closes an inlet in detail, and relates to the manufacture method for manufacturing a liquid crystal display, and equipment.

[0002]

[Description of the Prior Art] While the sealant was printed by the periphery except one inlet of the transparent substrate of the couple by which the transparent electrode and the orientation film were formed in the front face, after a spacer is sprinkled by the substrate of another side, both substrates pile up a liquid crystal display element, and it carries in a liquid crystal cell to an injector for a liquid crystal cell after ******, and where the inlet of this liquid crystal cell is turned downward, it makes the inside of equipment a vacua. Next, the inlet of a liquid crystal cell is made immersed in liquid crystal, the inside of equipment is returned to atmospheric pressure in this state, liquid crystal is poured in into a liquid crystal cell by the pressure differential of liquid crystal cell inside and outside, a liquid crystal cell is taken out from an injector after that, and an inlet is closed by the encapsulant.

[0003] The manufacture method of the conventional liquid crystal display element is shown in drawing 4 . While the sealant 13 was printed by one transparent substrate of the transparent substrates 11 and 12 of the couple by which the transparent electrode and the orientation film were formed in the front face at the periphery except the inlet 14, after the spacer which is not illustrated on another side is sprinkled, both substrates pile up, are put together, and the former and liquid crystal display element is assembled, pours in liquid crystal 15 from this inlet 14, and is manufactured by the method of closing an inlet 14.

[0004] In first, the state where carried in the liquid crystal cell 20 to the injector, and the inlet of this liquid crystal cell was turned downward as shown in drawing 4 (a) It sets in equipment and the inside of a chamber is made into a vacua. In the place where the inside of a liquid crystal cell would fully be in the vacua, it is drawing 4 (b). An inlet is made immersed in liquid crystal so that it may be shown, as shown in drawing 4 (c), the inside of equipment is returned to atmospheric pressure by inert gas, and liquid crystal is poured in into a liquid crystal cell by the pressure differential of liquid crystal cell inside and outside, it takes out from an injector, and as shown in drawing 4 (d), an inlet 14 is closed by the encapsulant 17 and it completes in the

[0005] A cell gap needs to be precisely controlled on the display quality of a liquid crystal display. However, by this

conventional method, since superfluous liquid crystal was poured in into the liquid crystal cell, the center section of the liquid crystal cell swelled, the cell gap became large, and there was a problem that a cell gap varied.

[0006] In order it solves the aforementioned problem, liquid crystal pours in too much, a cell side pressurizes with a roller, a press board, etc., surplus liquid crystal removes out of a cell, it changes into the technology (JP,60-24518,A) which refers to as suppressing dispersion in cell ** by closing an inlet, and the state pressed a liquid crystal cell from an outside before liquid-crystal pouring, liquid crystal pours into a liquid crystal cell, and the technology (JP,62-280719,A) which refers to as making cell ** uniform is exhibited.

[0007] However, when liquid crystal was poured in and closed with the aforementioned conventional technology, there were the following troubles. First, the gap adjustment method which extrudes the liquid crystal in a liquid crystal cell after liquid crystal pouring is a waste of expensive liquid crystal, and in order that a pressure plate may contact the liquid crystal cell screen, when the foreign matter etc. has adhered between the liquid crystal cell screen and a pressurization fixture side, a local pressure joins a liquid crystal cell front face, and a liquid crystal display element also has the problem of causing a poor display. Moreover, the liquid crystal after extrusion adheres near an inlet or to a pressure plate, and, in addition to the problem that a washing process is needed for both a cell and a pressure plate, the problem of taking time also has it in the knockout of this liquid crystal.

[0008] Moreover, by the pressurization pouring-in method, there are also a problem that the display of the liquid crystal display element by the local excess of a pressure described previously is poor, and a trouble that liquid crystal pouring time becomes long in addition to this from the vacuum pouring-in method which does not pressurize the conventional liquid crystal cell side.

[0009] Furthermore, when an encapsulant was hardened only by applying an encapsulant to an inlet after extruding the liquid crystal in a liquid crystal cell after liquid crystal pouring, there was a problem of closure intensity fully not being obtained since near an inlet can be closed, or causing poor closure. [0010] In order to solve these between title, the liquid crystal cell after pouring liquid crystal into a liquid crystal cell is pressurized by the vacuum pouring-in method, excessive liquid crystal is taken out from an inlet, where a cell is pressurized, an encapsulant is applied to an inlet, pressurization is once opened wide, an encapsulant is lengthened inside a liquid crystal cell and the technology of stiffening an

encapsulant from ****** is exhibited (JP,5-142506,A).

[0011] however, with the technology exhibited by this JP,5-142506,A, in order that a pressure plate may contact the liquid crystal cell screen as mentioned above, when the foreign matter etc. has adhered between the liquid crystal cell screen and a pressurization fixture side, there are also a problem that a local pressure joins a liquid crystal cell front face, and a liquid crystal display device causes a poor display, and a problem that an encapsulant will permeate the interior of a liquid crystal cell too much since welding pressure is opened wide at a stretch, and a poor display will occur

[0012]

[Problem(s) to be Solved by the Invention] this invention is performing pouring closure of liquid crystal consistently, where pressure control's is carried out, and even if it does not perform ****** and a mechanical gap adjustment process for the injection rate of liquid crystal precisely, gap precision is high and it aims at offering the manufacture method of an efficient liquid crystal display element with sufficient display quality and sufficient closure quality, and equipment.

[0013]

[Means for Solving the Problem] The first of this invention, the transparent substrate of the couple by which the transparent electrode was formed in one [which counters / at least] front face In the manufacture method of the liquid crystal display element which closes an inlet after turning an inlet for the liquid crystal cell which was made to counter at intervals of predetermined and carried out the seal of the periphery except an inlet down, being immersed in liquid crystal and pouring liquid crystal into the inside of a liquid crystal cell by the pressure differential of the internal pressure and external pressure of a liquid crystal cell It is in having solved the aforementioned technical problem by decompressing the external pressure of a liquid crystal cell rather than atmospheric pressure after liquid crystal pouring of the amount of conventions in a liquid crystal pouring process, and offering the manufacture method of the liquid crystal display element characterized by making it the external pressure of a liquid crystal cell and the internal pressure of a liquid crystal cell be in equilibrium.

[0014] A pressure-control means by which the second pressurizes or decompresses the pressure regulation room (A) in which pressurization and reduced pressure are possible, and this pressure regulation room for the interior of this invention (B), The transparent substrate of the couple which has the move mechanism which can move to this pressure regulation interior of a room vertically and horizontally and by which the

transparent electrode was formed in one [which counters / at least] front face The liquid crystal cell move means in which being immersed or ejection is possible to the liquid crystal which turned the inlet down, has arranged downward [vertical] the liquid crystal cell which was made to counter at intervals of predetermined and carried out the seal of the periphery except an inlet, and was supplied to the aforementioned pressure regulation interior of a room (C), A means (D) to supply liquid crystal to the aforementioned pressure regulation interior of a room, and a means (E) to supply the encapsulant which closes a liquid crystal cell to the aforementioned pressure regulation interior of a room are provided at least. in the aforementioned pressure regulation room (A) by the pressure differential of the internal pressure and external pressure of a liquid crystal cell It is in having solved the aforementioned technical problem by pouring liquid crystal into a liquid crystal cell, and offering the manufacturing installation of the liquid crystal display element characterized by being the thing of composition of that an inlet can be closed.

[0015] Hereafter, the manufacture method of the liquid crystal display element of this invention and a manufacturing installation are explained based on a drawing. Drawing 1 is the flow view showing the manufacture method of the liquid crystal display element of this invention. Carry out predetermined partition opposite of the transparent substrates 11 and 12 in which the transparent electrode which is not illustrated, the orientation film, etc. were formed, and the ** seal of the periphery except an inlet is carried out by the sealant 13. In the pressure regulation room 16 equipped with a means (following pressure-control means) by which the pressurization and reduced pressure which are not illustrated as a liquid crystal cell is assembled and it is shown in drawing 1 (a) can be performed arbitrarily It fixes to a conveyance means to provide the conveyance mechanism which can move vertically and horizontally in which the aforementioned liquid crystal cell 20 is not illustrated so that an inlet 14 may become downward [vertical], and the pressure regulation room 16 is decompressed.

[0016] Next, if the inside of the pressure regulation room 16 and a liquid crystal cell 20 is fully decompressed, will drop a liquid crystal cell 20 by the conveyance means which is not illustrated as shown in drawing 1 (b), and an inlet 14 will be immersed in liquid crystal 15. By changing the inside of the pressure regulation room 16 into atmospheric pressure and the pressurization state beyond it (following liquid crystal transfer pressure) with the pressure-control means which is not

illustrated, a pressure differential arises in the internal pressure and external pressure of a liquid crystal cell, and liquid crystal 15 is poured in into a liquid crystal cell 20.

[0017] Next, as shown in drawing 1 (c), when the liquid crystal of the proper quantity to which the center section of the liquid crystal cell does not swell in a liquid crystal cell 20 is poured in, the pressure regulation room 16 is decompressed with the pressure-control means which is not illustrated, external pressure in a liquid crystal cell is made into equilibrium (following pouring equilibrium pressure force), and pouring of the liquid crystal 15 into a liquid crystal cell 20 is stopped.

[0018] Next, a liquid crystal cell 20 is raised by the conveyance means which is not illustrated, and the inlet 14 of a liquid crystal cell 20 is pulled apart from liquid crystal 15. At this time, the pressure regulation room 16 is in a reduced pressure state, and since the external pressure in a liquid crystal cell is equilibrium, the contamination of the foam into a liquid crystal cell 20 does not happen. Here, as shown in drawing 1 (d), an encapsulant 17 is applied to an inlet 15 by the encapsulant supply means which is not illustrated in the pressure regulation room 16 under a reduced pressure state.

[0019] Next, the pressure regulation room 16 is pressurized with the pressure-control means which is not illustrated beyond the aforementioned pouring equilibrium pressure force (henceforth the encapsulant osmotic pressure 1). A pressure differential arises in the internal pressure and external pressure of a liquid crystal cell 20 by this, and an encapsulant 17 is drawn from an inlet 14 until the internal pressure and external pressure of a liquid crystal cell will be in equilibrium like the time of liquid crystal pouring. If osmosis of an encapsulant 17 stops, as shown in drawing 1 (e), by stiffening an encapsulant, the pouring closure process of a liquid crystal display element will be completed.

[0020] Moreover, when an encapsulant 17 permeates until the internal pressure and external pressure of a liquid crystal cell would be in equilibrium, When or there are few amounts of osmosis of an encapsulant than default value, or in shortening an encapsulant penetration time with the viscosity of the encapsulant to be used After it sets up closure osmotic pressure more highly (encapsulant osmotic pressure 2) and the encapsulant of the amount of conventions permeates, the method of decompressing again, making external pressure in a liquid crystal cell into equilibrium (closure equilibrium pressure force), and stopping osmosis of the encapsulant into a liquid crystal cell 20 is effective (closure osmosis process 2).

[0021] this invention thus, by performing pouring of liquid crystal, and a closure process, where pressure control is carried out By gap precision being high even if it skips a liquid crystal extrusion process, and being able to manufacture a liquid crystal display element with sufficient display quality, and skipping a liquid crystal extrusion process (1) Washing after the futility of extrusion liquid crystal, the poor display by (2) extrusion, and (3) extrusion and (4) extrusion time can be eliminated, and a liquid crystal display element can be manufactured efficiently.

[0022] An example of the pressure profile in the pressure regulation room 16 in the manufacturing installation of the liquid crystal display element of this invention is shown in drawing 2 . (a) - in drawing 2 (e) corresponds to drawing 1 (a) - (e). Among drawing, a dashed line expresses the aforementioned encapsulant osmosis process 2, (e') is the above (e) in the encapsulant osmosis process 2, and (f) is the reduced pressure point after the encapsulant of the amount of conventions permeates.

[0023] After decompressing the pressure regulation room 16, stopping pouring of liquid crystal 15 and applying an encapsulant 17 to an inlet 15 in the pressure regulation room 16 under a reduced pressure state with the exhaust which is not illustrated by (c) the time of the liquid crystal of optimum dose being poured in into a liquid crystal cell 20 so that drawing 2 may also show, (d) and the pressure regulation room 16 are pressurized. In the encapsulant osmosis process 2, when the encapsulant osmotic pressure 2 is set up more highly and an encapsulant carries out the amount osmosis of conventions, the pressure regulation room 16 was decompressed with the exhaust which is not illustrated, and osmosis of an encapsulant 17 is stopped.

[0024] Usually, the time of the liquid crystal of optimum dose being poured in into a liquid crystal cell 20, although (c) is mostly controllable by the kind of liquid crystal cell, when carrying out more precise pouring control, even if it is the cell of the same kind, it needs to measure the injection rate for every cell, and needs to control the reduced pressure point (c). It is ****** for measurement of the liquid crystal pouring field of the perpendicular direction of the method of measuring the distance of the perpendicular direction of the oil level in a liquid crystal cell and the oil level in a liquid crystal cell and the liquid crystal cell inside to carry out thickness measurement, or to control the reduced pressure point (c) based on those measured value by the combination of those measuring methods, in order to attain this.

[0025] The manufacturing installation of a liquid crystal display element is shown in drawing 3 . In the pressure regulation

room 16, a liquid crystal cell 20 is arranged downward [vertical], and the liquid crystal supply means 40 and the encapsulant supply means 41 are arranged. If liquid crystal is supplied and pouring of liquid crystal is begun by the pressure differential of liquid crystal cell inside and outside from the liquid crystal supply means 40, the pouring situation of the liquid crystal 15 in a liquid crystal cell 20 will be picturized by CCD camera 30, an image processing is carried out by the image-processing means 31, and the area of the non-poured in field 21 of liquid crystal is calculated. If the area of the non-poured in field 21 of liquid crystal becomes below default value, an instruction value will be sent to the pressure-control means 32, and the pressure-control means 32 will decompress the pressure regulation room 16. Even if this measures a pouring field, it is the same.

[0026] Moreover, this equipment is effective when controlling the point (f) in the encapsulant equipment process 2 decompressing [encapsulant osmosis] similarly. From an encapsulant supply means, supply an encapsulant, an encapsulant is made to permeate by the pressure differential of liquid crystal cell inside and outside, the osmosis situation of the encapsulant 17 in a liquid crystal cell 20 is picturized by CCD camera 30, an image processing is carried out by the image-processing means 31, and the area of an encapsulant osmosis field is calculated. If the area of an encapsulant osmosis field becomes more than default value, an instruction value will be sent to the pressure-control means 32, and the pressure-control means 32 will decompress the pressure regulation room 16. Moreover, for measurement of cell thickness, if a photosensor etc. is used, it can carry out.

[0027] Moreover, although the aforementioned thing moved the liquid crystal cell 20 fixed in the pressure regulation room 16 vertically and horizontally and performed supply of liquid crystal, and supply of a sealing agent, it may fix a liquid crystal cell 20 downward [vertical] conversely, may move a liquid crystal supply means and a sealing agent supply means, and may perform supply of liquid crystal and an encapsulant.

[0028]

[Effect] 1. The futility of the liquid crystal by fault pouring of claim 1 liquid crystal is lost, destruction of the liquid crystal cell by the foreign matter etc. is lost, and gap precision is high, and the manufacture method of a liquid crystal display element with sufficient display quality can be offered.

2. Even when the injection rate of liquid crystal varies between claim 2 cells, gap precision is high and the manufacture method of a liquid crystal display element with sufficient display quality can be

offered.

3. The manufacture method of a liquid crystal display element with a high gap precision without cellular mixing in claim 3 liquid crystal cell can be offered.

4. The manufacture method of a liquid crystal display element with sufficient claim 4 closure quality can be offered.

5. Claim 5 closure time can offer the manufacture method of a liquid crystal display element with sufficient closure quality short.

6. Even when the amount of osmosis of an encapsulant varies between claim 6 cells, the amount of osmosis of an encapsulant can be controlled and the manufacture method of a liquid crystal display element with sufficient closure quality can be offered short [closure time].

7. Even if it controls precisely the injection rate of seven to claim 8 liquid crystal and does not perform a mechanical gap adjustment process, highly, gap precision is efficient and can offer the manufacturing installation of a liquid crystal display element with still more sufficient display quality and closure quality.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the flow view of an example of the manufacture method of the liquid crystal display element of this invention.

(a) It is drawing fixed and arranged at the pressure regulation room 16 for a conveyance means to provide the conveyance mechanism which can move vertically and horizontally in which a liquid crystal cell 20 is not illustrated.

(b) It is drawing showing the state where dropped the liquid crystal cell 20 by the conveyance means, and the inlet 14 was immersed in liquid crystal 15.

(c) When the liquid crystal of optimum dose is poured in, it is drawing showing the state where made external pressure in a liquid crystal cell into equilibrium, and pouring of the liquid crystal 15 into a liquid crystal cell 20 was stopped.

(d) The external pressure in a liquid crystal cell is equilibrium, and is drawing showing the state where the encapsulant 17 was applied to the inlet 15 of a liquid crystal cell.

(e) It is drawing showing the state where pressurized the pressure regulation room 16 beyond the aforementioned pouring equilibrium pressure force, made the encapsulant 17 draw from the liquid crystal cell inlet 14, and the pouring closure process of a liquid crystal display element was completed.

[Drawing 2] It is drawing showing an example of the pressure profile in each stage of the pressure regulation interior of a room of drawing 1 . (a) The stage corresponding to each stage of (a) - (e) of drawing 1 in - (e), the stage in which the pouring closure process to the liquid

crystal display element in the encapsulant osmosis process 2 completed (e'), and (f) are the reduced pressure points after the encapsulant of the amount of conventions in the aforementioned process 2 permeates (encapsulant osmotic pressure was set up more highly and the encapsulant osmotic pressure 2 was reached).

[Drawing 3] It is drawing showing one example of the manufacturing installation of this invention.

[Drawing 4] It is the flow view showing the manufacture method of the conventional liquid crystal display element.

(a) The state which set the liquid crystal cell in equipment and made the inside of a chamber the vacuum where it carried in the liquid crystal cell 20 to the injector and the inlet of this liquid crystal cell is turned downward.

(b) The state where the inlet of a liquid crystal cell was made immersed in liquid crystal.

(c) The state which returned the inside of equipment to atmospheric pressure by inert gas, poured in liquid crystal into the liquid crystal cell by the pressure differential of liquid crystal cell inside and outside, and was taken out from the injector.

(d) The state which closed the inlet 14 by the encapsulant 17 and the pouring closure process of liquid crystal completed.

[Description of Notations]

11 Transparent Substrate
12 Transparent Substrate
13 Sealant
14 Inlet
15 Liquid Crystal
16 Pressure Regulation Room
17 Encapsulant
20 Liquid Crystal Cell
21 Non-Poured in Field of Liquid Crystal
30 CCD Camera
31 Image-Processing Means
32 Pressure-Control Means
40 Liquid Crystal Supply Means

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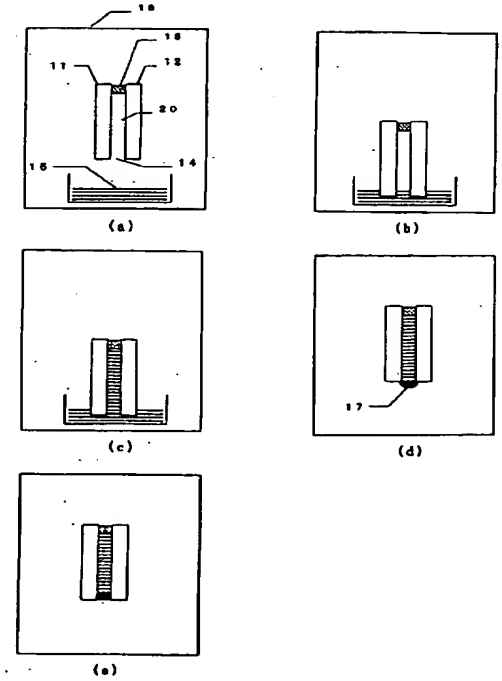
最終頁に続く

(54)【発明の名称】　液晶表示素子の製造方法および装置

(57)【要約】
【課題】　圧力制御された状態で液晶の注入封止を一貫して行うことで、液晶の注入量を精密に制御し、メカニカル的なギャップ調整工程を行わなくても、ギャップ精度が高く、効率よく表示品質および封止品質の良い液晶表示素子の製造方法及び装置の提供。
【解決手段】　対向する少なくとも一方の表面に透明電極が形成された一対の透明基板１１、１２を、所定間隔で対向させ注入口を除く周辺部をシール材１３によりシールした液晶セル２０を注入口１４を下にして圧力調節室１６内の液晶１５に浸漬し、液晶セル２０の内圧と外圧の圧力差により液晶セル２０の内に液晶を注入した後、注入口１４を封止する液晶表示素子の製造方法において、液晶注入工程において規定量の液晶１５を液晶セルに注入後、液晶セル２０の外圧を減圧し、液晶セル２０の外圧と液晶セル２０の内圧が平衡状態になるようにすることを特徴とする液晶表示素子の製造方法および装置。



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【特許請求の範囲】

【請求項１】　対向する少なくとも一方の表面に透明電極が形成された一対の透明基板を、所定間隔で対向させ注入口を除く周辺部をシールした液晶セルを注入口を下にして圧力調節室内の液晶に浸漬し、液晶セルの内圧と外圧の圧力差により液晶セルの内に液晶を注入した後、注入口を封止する液晶表示素子の製造方法において、液晶注入工程において規定量の液晶を液晶セルに注入後、液晶セルの外圧を減圧し、液晶セルの外圧と液晶セルの内圧が平衡状態になるようにすることを特徴とする液晶表示素子の製造方法。

【請求項２】　液晶注入工程において、液晶セル内の液面の垂直方向の面積を測定、液晶セル内の液面の垂直方向の液晶注入領域の測定、液晶セル内側の厚さ測定、あるいは、前記の測定方法を組み合わせて測定した測定結果に基づいて、圧力調節室内の液晶セルの外圧を減圧し、液晶セルの内圧と外圧が平衡状態になるようにする請求項１記載の液晶表示素子の製造方法。

【請求項３】　液晶セルの内圧と外圧が平衡状態になった後、液晶セルを封止剤で封止する請求項１～２のいずれかの項に記載の液晶表示素子の製造方法。

【請求項４】　液晶セルを封止剤で封止した後、液晶セルの外圧を加圧して適量の封止剤を浸透させて、液晶セルの内圧と外圧が平衡状態になった時点で、封止剤を硬化させる請求項３記載の液晶素子の製造方法。

【請求項５】　液晶セルの外圧を加圧して適量の封止剤を浸透させて、再び液晶セルの外圧を減圧し、液晶セルの内圧と外圧が平衡状態になった時点で、封止剤を硬化させる請求項４記載の液晶素子の製造方法。

【請求項６】封止剤の浸透状態を検出手段により検出して、該検出結果に基づき液晶セルの外圧を減圧し、液晶セルの内圧と外圧が平衡状態になった時点で、封止剤を硬化させる請求項５記載の液晶素子の製造方法。

【請求項７】　内部を加圧及び減圧が可能な圧力調整室（Ａ）、この圧力調整室を加圧または減圧する圧力制御手段（Ｂ）、この圧力調整室内に上下左右に移動可能な移動機構を有し、対向する少なくとも一方の表面に透明電極が形成された一対の透明基板を、所定間隔で対向させ注入口を除く周辺部をシールした液晶セルを、注入口を下にして鉛直下向きに配置して前記圧力調整室内に供給された液晶に浸漬または取り出し可能な液晶セル移動手段（Ｃ）、前記圧力調整室内に液晶を供給する手段（Ｄ）、および前記圧力調整室内に液晶セルを封止する封止剤を供給する手段（Ｅ）を少なくとも具備し、かつ前記圧力調整室（Ａ）内で液晶セルの内圧と外圧の圧力差により、液晶セルに液晶を注入し、注入口を封止できる構成のものであることを特徴とする液晶表示素子の製造装置。

【請求項８】　液晶セル内への注入状態および／または液晶セル内への封止剤の注入状態を撮像する手段、前記

2

撮像された画像を処理する手段、および前記処理結果に基づき圧力調整室を加圧、減圧する圧力制御手段を具備した請求項７記載の液晶表示素子の製造装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、液晶表示素子の製造方法およびその製造装置に関し、詳しくは液晶セルに液晶を注入し注入口を封止して、液晶表示装置を製造するための製造方法及び装置に関する。

【０００２】

【従来技術】液晶表示素子は、表面に透明電極と配向膜が形成された一対の透明基板の一方の注入口を除いた周辺部にシール材が印刷されるとともに、他方の基板にスペーサが散布された後、両基板が重ね合わされて液晶セルを組立た後、注入装置に液晶セルを搬入して、この液晶セルの注入口を下に向けた状態で装置内を真空状態にする。次に液晶セルの注入口を液晶に浸漬させ、この状態で装置内を大気圧に戻して液晶セル内外の圧力差により液晶セル内に液晶を注入し、その後注入装置から液晶セルを取り出し注入口を封止剤により封止する。

【０００３】図４に従来の液晶表示素子の製造方法を示す．従来、液晶表示素子は、表面に透明電極と配向膜が形成された一対の透明基板１１、１２の一方の透明基板に注入口１４を除いた周辺部にシール材１３が印刷されるとともに、他方に図示しないスペーサが散布された後、両基板が重ね合わされて組立てられており、この注入口１４から液晶１５を注入し、注入口１４を封止する方法で製造される。

【０００４】まず、図４（ａ）に示すように、注入装置に液晶セル２０を搬入してこの液晶セルの注入口を下に向けた状態で、 装置内にセットし、チヤンバー内を真空状態にする。液晶セル内が十分に真空状態になったところで、図４（ｂ） に示すように注入口を液晶に浸漬させ、図４（ｃ）に示すように装置内を不活性ガスにより大気圧に戻して液晶セル内外の圧力差により液晶セル内に液晶を注入し、注入装置から取り出し、図４（ｄ）に示すように注入口１４を封止剤１７にて封止して液晶の注入封止工程か完了する。

【０００５】液晶表示装置の表示品質上、セルギヤップは精密に制御される必要がある。しかし、この従来方法では、液晶セル内には過剰の液晶が注入されているために、液晶セルの中央部が膨らみ、セルギヤップが広くなり、セルギヤップがばらつくという問題があった。

【０００６】前記の問題を解決するために、液晶を余分に注入し、ローラ及び押圧板等でセル面を加圧して余剰液晶をセル外に除去し、注入口を封止することによりセル厚のばらつきを抑制すると言う技術（特開昭６０－２４５１８）、液晶注入前に液晶セルを外側から押圧した状態にして、液晶セルに液晶を注入しセル厚を均一にすると言う技術（特開昭６２－２８０７１９）が公開され

ている。

【０００７】しかしながら、前記従来技術で液晶を注入し、封止した場合は以下のような問題点があった。まず、液晶注入後に液晶セル内の液晶を押し出すギャップ調整法は高価な液晶の無駄遣いであり、また、液晶セル表示面と加圧板が接触するため、液晶セル表示面と加圧治具面間に異物等が付着していた場合、液晶セル表面に局所的な圧力が加わり液晶表示素子が表示不良を起こすという問題もある。また、押出し後の液晶が注入口付近、あるいは加圧板に付着しセルと加圧板の両方に洗浄工程が必要になるという問題に加えて、この液晶の押し出しには時間がかかるという問題もある。

【０００８】また、加圧注入法では先に述べた局所的な圧力過多による液晶表示素子の表示不良の問題と、その他、従来の液晶セル面を加圧しない真空注入法より液晶注入時間が長くなるという問題点もある。

【０００９】さらに、液晶注入後に液晶セル内の液晶を押し出した後、注入口に封止剤を塗布しただけで封止剤を硬化した場合、注入口付近しか封止できないため封止強度が十分に得られなかったり、封止不良を起こすという問題があった。

【００１０】これら問題を解決するために、真空注入法により液晶セルに液晶を注入後、液晶セルを加圧して注入口から余分な液晶を出して、セルに加圧した状態にて封止剤を注入口に塗布し、いったん加圧を開放し、封止剤を液晶セル内部に引き込んでから封止剤を硬化させるという技術が公開されている（特開平５－１４２５０６）。

【００１１】しかし、この特開平５－１４２５０６号で公開された技術では、前記のように液晶セル表示面と加圧板が接触するため、液晶セル表示面と加圧治具面間に異物等が付着していた場合、液晶セル表面に局所的な圧力が加わり、液晶表示素子が表示不良を起こすという問題や、加圧力を一気に開放しているために、封止剤が液晶セル内部に浸透しすぎて表示不良が発生してしまうという問題もある。

【００１２】

【発明が解決しようとする課題】本発明は、圧力制御された状態で液晶の注入封止を一貫して行うことで、液晶の注入量を精密に制御し、メカニカル的なギャップ調整工程を行わなくても、ギャップ精度が高く、効率よく表示品質および封止品質の良い液晶表示素子の製造方法及び装置を提供することを目的とする。

【００１３】

【課題を解決するための手段】本発明の第一は、対向する少なくとも一方の表面に透明電極が形成された一対の透明基板を、所定間隔で対向させ注入口を除く周辺部をシールした液晶セルを注入口を下にして液晶に浸漬し、液晶セルの内圧と外圧の圧力差により液晶セルの内に液晶を注入した後、注入口を封止する液晶表示素子の製造方法において、液晶注入工程において規定量の液晶注入後、液晶セルの外圧を大気圧よりも減圧し、液晶セルの外圧と液晶セルの内圧が平衡状態になるようにすることを特徴とする液晶表示素子の製造方法を提供することにより、前記課題を解決したことにある。

【００１４】本発明の第二は、内部を加圧及び減圧が可能な圧力調整室（Ａ）、この圧力調整室を加圧または減圧する圧力制御手段（Ｂ）、この圧力調整室内に上下左右に移動可能な移動機構を有し、対向する少なくとも一方の表面に透明電極が形成された一対の透明基板を、所定間隔で対向させ注入口を除く周辺部をシールした液晶セルを、注入口を下にして鉛直下向きに配置して前記圧力調整室内に供給された液晶に浸漬または取り出し可能な液晶セル移動手段（Ｃ）、前記圧力調整室内に液晶を供給する手段（Ｄ）、および前記圧力調整室内に液晶セルを封止する封止剤を供給する手段（Ｅ）を少なくとも具備し、かつ前記圧力調整室（Ａ）内で液晶セルの内圧と外圧の圧力差により、液晶セルに液晶を注入し、注入口を封止できる構成のものであることを特徴とする液晶表示素子の製造装置を提供することにより、前記課題を解決したことにある。

【００１５】以下、本発明の液晶表示素子の製造方法および製造装置を図面に基づいて説明する。図１は本発明の液晶表示素子の製造方法を示すフロー図である。図示しない透明電極、配向膜等が形成された透明基板１１，１２を所定間隔て対向させ注入口を除く周辺部をシール材１３によりてシールして、液晶セルを組み立て、図１（ａ）に示すように図示しない加圧及び減圧が任意に行える手段(以下圧力制御手段)を備えた圧力調整室１６に、前記液晶セル２０を注入口１４が鉛直下向きになるように図示しない上下左右に移動可能な搬送機構を具備する搬送手段に固定し、圧力調整室１６を減圧する。

【００１６】次に圧力調整室１６と液晶セル２０内が十分に減圧されたら、図１（ｂ）に示すように図示しない搬送手段により液晶セル２０を下降させ注入口１４を液晶１５に浸漬し、図示しない圧力制御手段で圧力調整室１６内を大気圧か、それ以上の加圧状態(以下液晶注入圧力)にすることにより、液晶セルの内圧と外圧に圧力差が生じて液晶セル２０内に液晶１５が注入される。

【００１７】次に図１（ｃ）に示すように、液晶セル２０内に液晶セルの中央部が膨らむことがない適量の液晶が注入された時点で、図示しない圧力制御手段で圧力調整室１６を減圧し、液晶セル内外圧を平衡状態（以下注入平衡圧力）にして液晶セル２０内への液晶１５の注入を止める。

【００１８】次に図示しない搬送手段により液晶セル２０を上昇させ、液晶セル２０の注入口１４を液晶１５から引き離す．この時、圧力調整室１６は減圧状態であり、液晶セル内外圧が平衡状態であるので液晶セル２０内への気泡の巻き込みは起こらない。ここで、図１

（ｄ）に示すように、減圧状態下の圧力調整室１６内で図示しない封止剤供給手段により注入口１５に封止剤１７を塗布する。

【００１９】次に図示しない圧力制御手段で圧力調整室１６を前記注入平衡圧力以上に加圧する（以下、封止剤浸透圧力１とも言う）。これにより液晶セル２０の内圧と外圧に圧力差が生じ、液晶注入時と同様に液晶セルの内圧と外圧が平衡状態になるまで封止剤１７が注入口１４から引き込まれる。封止剤１７の浸透が止まったら封止剤を硬化させることにより、図１（ｅ）に示すように液晶表示素子の注入封止工程が完成する。

【００２０】また、液晶セルの内圧と外圧が平衡状態になるまで封止剤１７が浸透した場合、使用する封止剤の粘度により封止剤の浸透量が規定値より多かったり、少なかったりする場合、あるいは封止剤浸透時間を短縮する場合には、封止浸透圧を高めに設定して（封止剤浸透圧力２）、規定量の封止剤が浸透した後、再び減圧して液晶セル内外圧を平衡状態（封止平衡圧力）にして液晶セル２０内への封止剤の浸透を止めるという方法が有効である（封止浸透プロセス２）。

【００２１】このように、本発明は、圧力制御された状態で液晶の注入、封止工程を行う事により、液晶押出工程を省略してもギャップ精度が高く、表示品質の良い液晶表示素子を製造することができ、また液晶押出工程を省略する事により、（１）押出し液晶の無駄、（２）押出しによる表示不良、（３）押出し後の洗浄、（４）押出し時間を排除する事ができ、効率よく液晶表示素子を製造する事ができる。

【００２２】図２に本発明の液晶表示素子の製造装置における圧力調整室１６内の圧力プロファイルの一例を示す。図２中の（ａ）～（ｅ）は図１（ａ）～（ｅ）に対応する。図中、１点鎖線は前記封止剤浸透プロセス２を表わし、（ｅ′）は封止剤浸透プロセス２における前記（ｅ）であり、（ｆ）は規定量の封止剤が浸透した後の減圧ポイントである。

【００２３】図２からもわかるように、液晶セル２０内に適量の液晶が注入された時点（ｃ）で、図示しない排気装置により、圧力調整室１６を減圧し、液晶１５の注入を止め、減圧状態下の圧力調整室１６内で、注入口１５に封止剤１７を塗布した後（ｄ）、圧力調整室１６を加圧している。封止剤浸透プロセス２においては、封止剤浸透圧力２を高めに設定し、封止剤が規定量浸透した時点で、図示しない排気装置により圧力調整室１６を減圧し、封止剤１７の浸透を止めている。

【００２４】通常、液晶セル２０内に適量の液晶が注入された時点（ｃ）は、ほぼ液晶セルの種類により制御可能であるが、より精密な注入制御をする場合には同一種類のセルであってもセルごとにその注入量を測定し、減圧ポイント（ｃ）を制御する必要がある。これを達成するためには、液晶セル内の液面の垂直方向の距離を測定

する方法や、液晶セル内の液面の垂直方向の液晶注入領域の測定、また、液晶セル内側の厚さ測定し、あるいは、それらの測定方法の組み合わせによるそれらの測定値に基づいて減圧ポイント（ｃ）を制御することができる。

【００２５】図３に、液晶表示素子の製造装置を示す。圧力調整室１６内に液晶セル２０が鉛直下向きに配置され、液晶供給手段４０と封止剤供給手段４１が配設されている。液晶供給手段４０より液晶を供給し、液晶セル内外の圧力差により液晶の注入を始めるとＣＣＤカメラ３０で液晶セル２０内の液晶１５の注入状況を撮像し、画像処理手段３１により画像処理し、液晶の未注入領域２１の面積を演算する。液晶の未注入領域２１の面積が規定値以下になったら、圧力制御手段３２に指令値を送り圧力制御手段３２は圧力調整室１６を減圧する。これは注入領域を計測しても同じである。

【００２６】また、同様に封止剤装置プロセス２における封止剤浸透減圧点（ｆ）を制御する場合にもこの装置は有効である。封止剤供給手段より封止剤を供給し、液晶セル内外の圧力差により封止剤を浸透させ、ＣＣＤカメラ３０で液晶セル２０内の封止剤１７の浸透状況を撮像し、画像処理手段３１により画像処理し、封止剤浸透領域の面積を演算する。封止剤浸透領域の面積が規定値以上になったら、圧力制御手段３２に指令値を送り、圧力制御手段３２は圧力調整室１６を減圧する。また、セル厚さの測定には、光センサ等を用いれば実施できる。

【００２７】また、前記のものは圧力調整室１６内に固定した液晶セル２０を上下左右に移動させて液晶の供給及び封止材の供給を行ったが、逆に液晶セル２０を鉛直下向きに固定して、液晶供給手段と封止材供給手段を移動させて液晶及び封止剤の供給を行っても良い。

【００２８】

【効果】１．請求項1

液晶の過注入による液晶の無駄を無くし、また異物等による液晶セルの破壊を無くして、かつ、ギャップ精度が高く、表示品質の良い液晶表示素子の製造方法を提供できる。

２．請求項２

セル間で液晶の注入量がばらつく場合でも、ギャップ精度が高く、表示品質の良い液晶表示素子の製造方法を提供できる。

３．請求項３

液晶セル内に気泡混入の無いギャップ精度の高い液晶表示素子の製造方法を提供できる。

４．請求項４

封止品質の良い液晶表示素子の製造方法を提供できる。

５．請求項５

封止時間が短く、かつ封止品質の良い液晶表示素子の製造方法を提供できる。

６．請求項６

セル間で封止剤の浸透量がばらつく場合でも、封止剤の浸透量を制御でき、かつ封止時間の短く、また封止品質の良い液晶表示素子の製造方法を提供できる。

７．請求項７～８

液晶の注入量を精密に制御し、メカニカル的なギャップ調整工程を行わなくても、ギャップ精度が高く、また効率よく、さらに表示品質および封止品質の良い液晶表示素子の製造装置を提供できる。

【図面の簡単な説明】

【図１】本発明の液晶表示素子の製造方法の一例のフロー図である。

（ａ）圧力調整室１６に、液晶セル２０を図示しない上下左右に移動可能な搬送機構を具備する搬送手段に固定して配置した図である。

（ｂ）搬送手段により液晶セル２０を下降させ注入口１４を液晶１５に浸漬した状態を示す図である。

（ｃ）適量の液晶が注入された時点で、液晶セル内外圧を平衡状態にして液晶セル２０内への液晶１５の注入を止めた状態を示す図である。

（ｄ）液晶セル内外圧が平衡状態で、液晶セルの注入口１５に封止剤１７を塗布した状態を示す図である。

（ｅ）圧力調整室１６を前記注入平衡圧力以上に加圧し、封止剤１７を液晶セル注入口１４から引き込ませ、液晶表示素子の注入封止工程が完成した状態を示す図である。

【図２】図１の圧力調整室内の各段階における圧力プロファイルの一例を示す図である。（ａ）～（ｅ）は図１の（ａ）～（ｅ）のそれぞれの段階に対応した段階、（ｅ′）は封止剤浸透プロセス２における液晶表示素子への注入封止工程が完了した段階、（ｆ）は前記プロセス２における規定量の封止剤が浸透した（封止剤浸透圧を高めに設定し封止剤浸透圧力２に到達した）後の減圧ポイントである。

【図３】本発明の製造装置の１実施例を示す図である。

【図４】従来の液晶表示素子の製造方法を示すフロー図である。

（ａ）注入装置に液晶セル２０を搬入してこの液晶セルの注入口を下に向けた状態で、装置内に液晶セルをセットし、チャンバー内を真空にした状態。

（ｂ）液晶セルの注入口を液晶に浸漬させた状態。

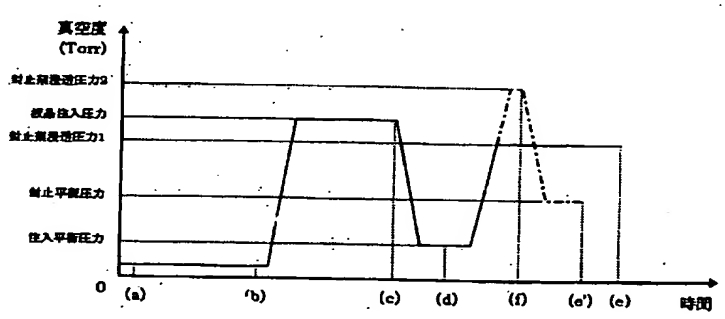
（ｃ）装置内を不活性ガスにより大気圧に戻して液晶セル内外の圧力差により液晶セル内に液晶を注入し、注入装置から取り出した状態。

（ｄ）注入口１４を封止剤１７にて封止して液晶の注入封止工程が完了した状態。

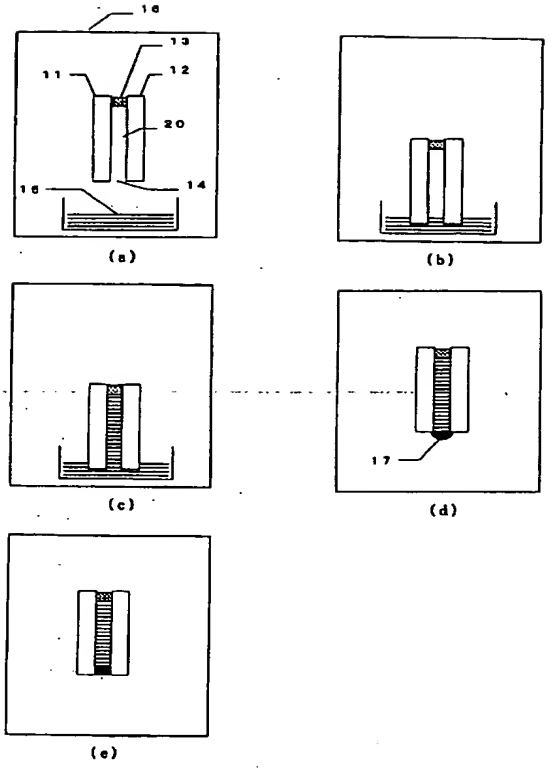
【符号の説明】

１１　透明基板
１２　透明基板
１３　シール材
１４　注入口
１５　液晶
１６　圧力調整室
１７　封止剤
２０　液晶セル
２１　液晶の未注入領域
３０　ＣＣＤカメラ
３１　画像処理手段
３２　圧力制御手段
４０　液晶供給手段

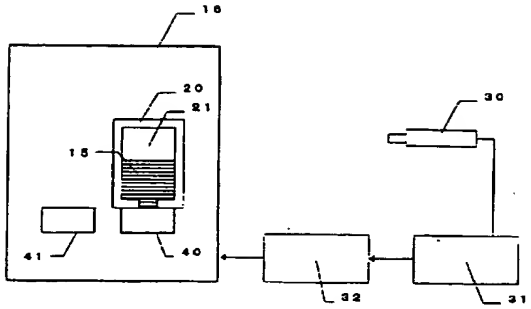
【図２】



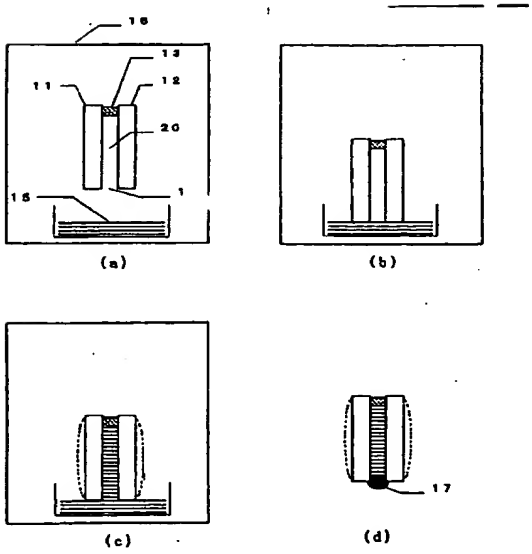
【図１】


16
13
11
12
20
14
15
(a)
(b)
(c)
17
(d)
(e)

【図３】


16
20
21
15
30
41
40
32
31

【図４】


16
13
11
12
20
15
1
(a)
(b)
(c)
17
(d)

フロントページの続き

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